Notes on Completion: Please refer to the appropriate NIA Governance Document to assist in the completion of this form. The full completed submission should not exceed 6 pages in total.

NIA Project Registration and PEA Document

Date of Submission

Mar 2014

Project Reference Number

NIA_NGET0056

Project Registration

Project Title

Humber Smartzone Pilot Project

Project Reference Number

NIA_NGET0056

Project Licensee(s)

National Grid Electricity Transmission

Project Start

January 2011

Project Duration

6 years and 3 months

Nominated Project Contact(s)

Mark Osborne

Project Budget

£1,491,000.00

Summary

The project aims to develop and demonstrate a proof of concept to provide flexible enhanced circuit ratings using a combination of wide area monitoring, predictive ratings and dynamic security analysis. The project will combine a number of related innovation work streams, including predictive ratings, wide area monitoring and network automation which together could potentially enhance the network performance without the need for building new capacity.

The initial analysis has demonstrated the feasibility of the concept, the next phase will aim to prove the concept and its applicability on the Electricity Transmission system.

The project aims to develop and demonstrate a solution which coordinates the use of various dynamic and wide area monitoring techniques:

- Tools which measure, monitors and predicts the thermal capacity in a circuit.
- Develop an application to estimate the thermal capacity margin in the region on a real time and predictive basis (24hrs or more).
- Advisory system to coordinate plant and equipment maximising the utilisation of the network without having to install new circuits or conductors.

A number of devices including phasor measurement units (PMU) and dynamic circuit monitoring systems will be installed to provide network data. Weather forecasting and network analysis will be combined with the field data to develop a control algorithm which will optimise circuit ratings using available systems and manage the power flow within the region using power flow controllers (QBs) and generator governor controls to manage power input and output.

The Smartzone project is a staged programme which commenced in 2011 and completes in 2017. The pilot will be located in the Humber Estuary where there will be a concentration of conventional & renewable generation to challenge the Connect & Manage regime.

Nominated Contact Email Address(es)

box.NG.ETInnovation@nationalgrid.com

Problem Being Solved

National Grid has a licence obligation to connect customers in a secure, reliable and efficient manner. Until relatively recently the necessary transmission system capacity to securely accomodate full name plate generation output had to be made firm and be in place prior to the connection of the customer. Recent changes in Regulation and Grid Code requirements have introduced ‘Connect & Manage’. This allows generation to connect earlier than before and use any ‘spare' network capacity. Commercial mechanisms such as constraints are then used to manage marginal requirements if there is insufficient capacity to export full output power at the time of use.

Network capacity and circuit ratings are established using a standard deterministic design practice which calculates the rating based on worse case criteria, seasonal conditions and operational scenarios. While this is a conservative rating regime, this provides confidence that the network will be robust to most credible scenarios. As more intermittent and embedded generation connects to the network, a more ‘flexible’ approach to ratings offers the opportunityto enhance the circuit rating if the weather conditions are favourable. So far applying these concepts has proved to be difficult in planning and operational timeframes as these timeframes require forecasts of future conditions which brings inherent uncertainty. Particular uncertainties that need to be addressed before changes to operational practices can be implemented include, but are not limited to, the follow:

- What level of confidence is there that this method will work without unacceptable compromise to security of supply?
- What value could this potentially provide?
- Can the technical and commercial risks be addressed and managed?
- What is the most suitable approach to implement this approach?

This project aims to coordinate and build on work already carried out using real time and dynamic ratings, particularly where the performance of overhead line ratings can be enhanced during periods of high wind, removing the need to build new circuits.

This approach will require much more asset information, meteorological data and network awareness to establish ratings appropriate to the current and above all forecast ambient conditions the network will be exposed to. Due to its low cost and relative speed of implementation (compared to building a new line), there is a lot of potential value in developing this technique. Enhancing our understanding of the viability of this, and of the challenges and opportunities surrounding it, would provide new learning that would allow the industry to realise a methodology that has the potential to cost-effectively address the challenges of transitioning to a low carbon economy.

Method(s)

This project will develop a Transmission Capacity Assessment System that will inform and predict the total capacity in the circuits. This will then give National Grid a methodology for calculating unused capacity in the Transmission system, and take appropriate action in order to maximise power flow.

Phase 1 - Research (completed with IFI funding)

A desktop and feasibility study and analysis has been carried out to investigate the potential to use flexible ratings to deliver enhanced capacity.

- Optimum methods and benefits of different methods to provide circuit capacity enhancement (using QBs, dynamic ratings and operational tripping).
- Assess the state of the art and communication architecture for a dynamic rating controlled operational tripping scheme.
- Develop test facility to assess and test suitability of PMUs for managing Wide Area Control.
- Install dynamic line rating modules for real time monitoring.

The project has produced reports covering all of these aspects.

Phase 2 - Develop and Trial (2014 – 2017)

Specifically, the pilot will aim to demonstrate:

- The logistical challenges of monitoring to facilitate capacity enhancement.
- Development of a capacity margin management tool to define the actual enhanced flexible capacity available in a small region of the

network, using predictive ratings, wide area monitoring and network analysis.

- The technical challenges around using flexible ratings in network planning & operation.
- Monitor and assess accuracy and performance against the current system to provide confidence in the method.
- Produce specifications and guidance documentation for operational roll out.

The project will produce reports and demonstrations to share learning on the aforementioned areas.

Scope

The project aims to develop and demonstrate a proof of concept to provide flexible enhanced circuit ratings using a combination of wide area monitoring, predictive ratings and dynamic security analysis. The project will combine a number of related innovation work streams, including predictive ratings, wide area monitoring and network automation which together could potentially enhance the network performance without the need for building new capacity.

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Objective(s)

To trial and monitor the performance of a wide area monitoring system, that enables National Grid to temporarily increase the quantity of power that can be safely and reliably transmitted through the existing network of circuits in a group. The method coordinates asset performance with network awareness and monitoring to optimize the thermal capacity of circuits. This will be particularly beneficial for periods coincident with high volumes of wind generation on the network.

Consumer Vulnerability Impact Assessment (RIIO-2 Projects Only)

n/a

Success Criteria

The output of the project will be deemed successful when National Grid has assessed the viability of the concept through a proof of concept demonstration, and assessed the performance in parallel with the existing control measures.

Interim criteria to measure success is as follows:

- Source and install sensors,
- Test platform to proveand exercise capacity enhancement tools,
- Produce specifications and procedures for implementation.

Project Partners and External Funding

n/a

Potential for New Learning

n/a

Scale of Project

The project is being delivered on a small, discrete area of the network. This will enable National Grid to demonstrate proof of concept. Demonstration at the scale of a group of circuits which intheir own right form a meshed network is required in order to assess the capabilities of this approach in managing powerflow over a number circuit loading combinations. The scale of the project cannot be reduced further and still meet the objectives of assessing the value of rolling out this approach to the GB network.

Technology Readiness at Start

TRL5 Pilot Scale

Technology Readiness at End

TRL7 Inactive Commissioning

Geographical Area

This demonstration is being undertaken in the Humber region.

Revenue Allowed for the RIIO Settlement

None.

Indicative Total NIA Project Expenditure

IFI: £467,455

NIA: £1,023,545

Project Eligibility Assessment Part 1

There are slightly differing requirements for RIIO-1 and RIIO-2 NIA projects. This is noted in each case, with the requirement numbers listed for both where they differ (shown as RIIO-2 / RIIO-1).

Requirement 1

Facilitate the energy system transition and/or benefit consumers in vulnerable situations (Please complete sections 3.1.1 and 3.1.2 for RIIO-2 projects only)

Please answer **at least one** of the following:

How the Project has the potential to facilitate the energy system transition:

n/a

How the Project has potential to benefit consumer in vulnerable situations:

n/a

Requirement 2 / 2b

Has the potential to deliver net benefits to consumers

Project must have the potential to deliver a Solution that delivers a net benefit to consumers of the Gas Transporter and/or Electricity Transmission or Electricity Distribution licensee, as the context requires. This could include delivering a Solution at a lower cost than the most efficient Method currently in use on the GB Gas Transportation System, the Gas Transporter's and/or Electricity Transmission or Electricity Distribution licensee's network, or wider benefits, such as social or environmental.

Please provide an estimate of the saving if the Problem is solved (RIIO-1 projects only)

National Grid's Ten Year Statement indicates that significant volumes of renewable generation will connect to network. The Humber estuary is a major generation hub and is expected to be one of the main grid entry points for offshore renewable generation. Network analysis indicates that the current static circuit capacity will be exceeded by 2019 and that constraint costs in the region will rise as a result of more renewable energy connecting to the network, unless additional capacity can be secured.

Feasibility studies suggest that improvements brought around through the provision of coordinating dynamic ratings and network automation will facilitate increased capacity without the need to reconductor or build new circuits. A conservative estimate indicates that an increase of 5% in circuit capacity would reduce constraint costs by approx 10%; Based on current costs, estimates indicate up to £5m pa savings could be achieved through implementing the Humber Smartzone pilot. Constraints are not a constant cost and very much depend on circumstances, however for indication savings on a specific circuit this could equate to between £350,000 & £750,000 a day.

Please provide a calculation of the expected benefits the Solution

Base - National Grid currently has 3 options for addressing circuit capacity shortfall where overhead conductor is the limiting factor: each one has different costs, benefits and drawbacks:

1. Build new capacity– c£100m for a new circuit. Adds significant permanent capacity but is the most expensive option and requires planning approval and will take many years.

2. Reconductor existing circuits – costs c£10-30m. Requires a long outage to replace conductors, typical increase in permanent rating of 20-50% depending on circuit and tower configurations.

3. Constrain off generation - c£5m pa as detailed above. Does not provide additional capacity but provides a management mechanism. Limits the connection of renewable generation.

Method - Install wide area monitoring system, allowing National Grid to utilise existing capacity c£1m for an equivalent area

Therefore, Base cost (using the lowest cost option described above)-Method = £5m - £1m = £4m (based on thermal constraint costs in the Humber region.

Please provide an estimate of how replicable the Method is across GB

The proof of concept considers overhead line circuits, however, the principle behind wide area monitoring and network awareness could be made applicable to many parts of the whole of the UK Transmission System.

Please provide an outline of the costs of rolling out the Method across GB.

The Humber zone is small part of the GB network (under 5%) of the National Grid network, although is a key generation import region. Therefore using project costs to extrapolate, the roll out cost of this concept would be in the region of £30-50m.

Requirement 3 / 1

Involve Research, Development or Demonstration

A RIIO-1 NIA Project must have the potential to have a Direct Impact on a Network Licensee's network or the operations of the System Operator and involve the Research, Development, or Demonstration of at least one of the following (please tick which applies):

☑ A specific piece of new (i.e. unproven in GB, or where a method has been trialled outside GB the Network Licensee must justify repeating it as part of a project) equipment (including control and communications system software).

☑ A specific novel arrangement or application of existing licensee equipment (including control and/or communications systems and/or software)

☑ A specific novel operational practice directly related to the operation of the Network Licensees system

☐ A specific novel commercial arrangement

RIIO-2 Projects

☐ A specific piece of new equipment (including monitoring, control and communications systems and software)

☐ A specific piece of new technology (including analysis and modelling systems or software), in relation to which the Method is unproven

☐ A new methodology (including the identification of specific new procedures or techniques used to identify, select, process, and analyse information)

☐ A specific novel arrangement or application of existing gas transportation, electricity transmission or electricity distribution equipment, technology or methodology

☐ A specific novel operational practice directly related to the operation of the GB Gas Transportation System, electricity transmission or electricity distribution

☐ A specific novel commercial arrangement

Specific Requirements 4 / 2a

Please explain how the learning that will be generated could be used by the relevant Network Licensees

Although work has been carried on real time dynamic ratings, there is little currently known about the ability to incorporate temporary enhanced ratings into utility planning and operation. The project will enhance understanding of the technical and commercial viability of this method and identify potential value and opportunities, barriers and areas for further research. Therefore, the findings could benefit other transmission and distribution network operators.

Outputs will be shared with the energy industry via dissemination events, which will be open to licensees, and material from the project will be available to the general public via the ENA portal.

Or, please describe what specific challenge identified in the Network Licensee's innovation strategy that is being addressed by the project (RIIO-1 only)

n/a

☑ Has the Potential to Develop Learning That Can be Applied by all Relevant Network Licensees

Is the default IPR position being applied?

☑ Yes

Project Eligibility Assessment Part 2

Not lead to unnecessary duplication

A Project must not lead to unnecessary duplication of any other Project, including but not limited to IFI, LCNF, NIA, NIC or SIF projects already registered, being carried out or completed.

Please demonstrate below that no unnecessary duplication will occur as a result of the Project.

n/a

If applicable, justify why you are undertaking a Project similar to those being carried out by any other Network Licensees.

n/a

Additional Governance And Document Upload

Please identify why the project is innovative and has not been tried before

n/a

Relevant Foreground IPR

n/a

Data Access Details

n/a

Please identify why the Network Licensees will not fund the project as apart of it's business and usual activities

n/a

Please identify why the project can only be undertaken with the support of the NIA, including reference to the specific risks(e.g. commercial, technical, operational or regulatory) associated with the project

n/a

This project has been approved by a senior member of staff

☑ Yes